loop. Specifically, a splitter is a passive electronic filter that may be attached to the loop in order to split or separate the low and high frequency portion of the loop. The functions of frequency splitting are entirely different from packet (or any other form of) switching. A splitter simply subdivides a physical conductor (i.e, the loop) into two separate transmission channels based upon frequency. It is a very rudimentary form of multiplexing, because it permits two distinct signals on a single conductor.[38]

64. Adding a splitter to a loop is analogous, in all relevant technical respects, to adding or removing of other loop electronics, such as bridge taps, load coils, or conditioners. In fact, splitters and load coils are composed of the same type of electronics: inductors. Moreover, attaching an ILEC-owned splitter is analogous to an ILEC's conditioning of a loop to minimize loss by disconnecting the cross-connect between the loop and port and inserting an enhancer onto the loop.[39] Finally, adding a splitter is necessary to provide voice service when a customer also requests advanced data service over the same line, a configuration that is crucial to the development of a competitive market for advanced services.[40]

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[38] In essence, the splitter allows a carrier to use one physical loop facility for two (or more) simultaneous transmissions, thus creating two (or more) "virtual" loops within one physical loop. The existence of the two or more virtual loops permits one to carry the telecommunications (typically, although not necessarily, voice service) in the low-frequency spectrum (300-3400 MHz) and the other to carry telecommunications (typically, although not necessarily, data services) in the high-frequency spectrum.

[39] In both cases, the modification of the loop is accomplished by disconnecting the cross-connect between the loop and the switch-port and cross-connecting over to electronics that are attached to the loop.

[40] For all of these reasons, arbitrators in Texas have recently found that splitters should be considered attached electronics that are a part of the loop element. *Arbitration Award, Petition of Southwestern Bell Telephone Company for Arbitration with AT&T Communications of Texas*, Docket No. 22315, at 17 (Sep. 13, 2000).

V. IN A NEXT-GENERATION ARCHITECTURE, NEITHER REMOTE TERMINAL COLLOCATION NOR SPARE COPPER IS A VIABLE COMPETITIVE OPTION FOR CLECS.

A. Remote Terminal Collocation Is Not Viable for CLECs

65. One theoretically possible way for CLECs to be able to offer advanced services is to place their equipment in the remote terminal and use this equipment to connect to the copper subloop coming from the subscriber's premises. Under this scenario, competitors would bypass the ILEC's transmission equipment inside the remote terminal (and may even bypass the loop feeder plant). As a result, remote terminals and/or SAIs have unquestionably become a critical interconnection and collocation point in this new network, as they are now the gateway to the shorter copper loops (or more properly subloop facilities) that lead to customers' premises.[41] As the Commission has correctly found: "[i]n cases where the incumbent multiplexes its copper loops at a remote terminal to transport the traffic to the central office over fiber DLC facilities, a requesting carrier's ability to offer xDSL service to customers served over those facilities will be precluded, unless the competitor can gain access to the customer's copper loop before the traffic on that loop is multiplexed. Thus, we note that the remote terminal has, to a substantial degree, assumed the role and significance traditionally associated with the central office."[42] Accordingly, the Commission required ILECs to allow competitors access to remote terminals and the subloop facilities that extend from the remote terminal.

66. Although it is important that CLECs have access to the remote terminals, any claim that CLECs can collocate their own stand-alone electronics at the remote terminals in a manner that would support mass-market competition simply ignores reality. While remote

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41 *SBC Waiver Order* ¶ 33.

42 *UNE Remand Order* ¶ 218.

terminal collocation may be theoretically possible, there is little prospect that it could provide a practical competitive alternative for CLECs. In order for a CLEC to deploy its own remote electronics, it generally must have access to the following:

- a physical location in which to deploy its equipment;
- power to run the equipment and heat, ventilation, and perhaps air conditioning ("HVAC") to control the equipment environment; and
- efficient means to connect and modify cross-connection of the equipment to other necessary facilities, such as the copper pair on the customer's side of the remote terminal and fiber feeder facilities (both data and voice) back to the central office.

As discussed below, the recent deployment of electronics at RTs only serves to heighten, not diminish, barriers to the CLECs' replication of the ILEC plant.

67. Space constraints will generally prevent more than one carrier (including the ILEC's advanced services affiliate) from placing electronics in a traditional collocation at a particular remote terminal. Existing remote terminals were sized for the area and service mix they were expected to serve at the time they were built, and therefore are unlikely to have spare space for competitive LEC equipment (unless the ILEC's forecast grossly overstated demand). Indeed, the ILECs have openly admitted that RTs are typically housed in small cabinets that have not been deployed with any excess space to accommodate any additional CLEC equipment. SBC, for example, has previously advised the Commission that "there is little or no excess space in cabinets," which are the most prevalent of the three types of remote terminals currently deployed.[43] Verizon and BellSouth also advised the Commission that the majority of existing

[43] *See* SBC Letter to Lawrence R. Strickling, Chief, Common Carrier Bureau, Federal Communications Commission, CC Docket No. 98-141 - Ownership of Plugs/Cards and OCDs, February 15, 2000, at 2 ("SBC Letter").

and planned future cabinets lack sufficient space to accommodate collocation of equipment for even a single competitor, much less several.[44]

68. Even where there may be some extra space, remote terminals are relatively small and inherently incapable of supporting industry wide access to retail customers.[45] For example, based on my experience, pole mounted cabinets are so small that they would hardly, if ever, have sufficient space to accommodate additional equipment.

69. Ground-mounted cabinets present several additional challenges that make RT collocation impracticable, if not impossible, to implement. Exhibit D depicts the installation of the cabinet cable entrance template. The template is a metallic feature that is typically imbedded in poured concrete to accommodate the number of conduits designed to feed the cabinets based upon prescribed cable arrangements. Typically, as in this example, only four conduits are fed into the cabinet. These four conduits represent: (1) the fiber cable that links the RT equipment to the central office; (2) the copper cable that terminates the derived feeder pairs from the DLC equipment into a minimum of one SAI; (3) a maintenance spare conduit to facilitate the replacement of any of the "working" cables in the event of a catastrophic failure; and (4) possibly, in best case scenarios, one spare conduit.[46]

70. The ground-mounted cabinet is bolted to the metallic template. The cables entering the cabinets are spliced to protector terminals in a hardwired fashion, which in turn are

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[44] *See* NGRT Public Forum, Transcript at 22-24.

[45] *See* NGRT Public Forum, Transcript at 20-23 (ILEC representatives acknowledge the lack of space in remote terminals).

[46] Often, this conduit is not "spare" at all, but rather is filled with a copper cable that feeds another SAI.

"factory" hardwired to the DLC equipment appearances. Typically, each cabinet is designed to house a specific amount of equipment and its associated ancillary hardware (*e.g.* rectifiers, heat exchangers, back-up batteries, splice chambers, etc). Thus, ground-mounted cabinets are virtually impossible to access once they are deployed and their entrance facilities are utilized.

71. The Commission recently began to address these limitations in its review of the SBC/Ameritech merger conditions. In exchange for modifications to its merger conditions, SBC "committed" to make available additional collocation space in its remote terminals.[47] However, even if SBC fulfilled all of its obligations expeditiously, in good faith, and in a manner that resolved every other concern, this would only enable a handful of unaffiliated carriers to deploy electronics in select remote terminal locations that serve a small fraction of the customers in the incumbent ILECs' territories. These commitments, in themselves, simply do not ensure that CLECs have a meaningful opportunity to compete with the ILECs (and their affiliates) on a mass-market basis.

72. While cabinets are by far the most common form of remote terminal, even larger RTs, such as CEVs, have little or no space available to accommodate competitive carriers. CEVs, like other RTs, have been designed to handle specific service capacity and, accordingly, they also have limited space available for additional equipment. Generally, a CEV could accommodate only one rack of equipment, which cannot support a diverse set of competitors with a variety of equipment deployment needs. Furthermore, this space is rarely "available" to

[47] *SBC Waiver Order* ¶¶ 34-35, 37. In particular, SBC has committed to: (i) make a limited percentage of space (15 to 25 percent) in its remote terminals available to CLECs; (ii) provide an adjacent collocation structure to requesting carriers; (iii) establish a process by which its ILECs will make available additional space in existing remote terminals; (iv) commence a forum to explore technical and operational issues related to competitive access

competitive carriers because it is frequently used for mounting equipment related to high speed services or special needs of the ILEC (or its data affiliate). In Exhibit E, I provide photographs of an actual, in-service CEV.

73. Even where remote terminal space is available for collocation, it is unlikely that the space will also have the power and HVAC necessary for proper deployment of a CLEC's electronics. Equipment cabinets rely on heat exchangers to dissipate the heat generated by the equipment. The actual placement of equipment -- as well as its power consumption -- would dictate whether it could function in the existing cabinets (designed and/or deployed). Moreover, housings of all descriptions generally rely on some sort of back-up power supply (usually bulk batteries) to ensure some amount of operational time in the event of a power failure. The battery back-up is designed based on what was perceived as the normal power consumption when it was originally installed. Thus, the addition of higher power consuming equipment, coupled with the different pattern of traffic usage, would unlikely render existing back-up power arrangements inadequate.

74. Further, even if the remote terminal space is available for collocation and has the necessary power and HVAC, there is typically no way to cross-connect facilities efficiently within the remote terminal. This is because cross-connection to customer pairs is usually done at the SAI, *not* at the remote terminal itself. As a result, the feeder facilities to the central office are generally hardwired to the ILEC's transmission equipment, such as the DLC, not wired to a frame-like device that permits flexible cross-connection to other service providers. Thus, even if

to remote terminals; and (v) establish a "special construction arrangement," to address space, power, connectivity, and related collocation issues.

CLECs could collocate their equipment at a remote terminal, that equipment cannot be connected to the customer's loop at that point.

75. Collocation at other points such as the SAI is also not a viable alternative. In most instances, SAIs are too small to accommodate deployment of any additional equipment (such as transmission equipment or DSLAM functionality). Moreover, SAIs are not designed to provide the necessary power and HVAC for collocation equipment because they typically house only a set of cross-connection blocks, which do not require environmental conditioning.

76. For collocation at the SAI to be even remotely practical from a technical perspective, one would need to ensure that the CLEC could:

- obtain the necessary permissions to construct a parallel SAI within the ILEC's right of way (and even if one CLEC could gain such permission, subsequent CLECs would likely encounter significant resistance);
- obtain from the ILEC use of its rights of way (or obtain its own);
- economically deploy or obtain feeder plant to re-home a portion of the subscribers terminating on the ILECs' SAIs to the CLEC-deployed remote terminal; and
- obtain rights of ways and economically deploy or obtain high-bandwidth feeder plant to connect its remote terminal/DLC either to a collocation within the ILEC's central office or directly to its own network.[48]

Even assuming that CLECs could obtain the necessary rights of way and capital to self-provision such facilities, deployment of any equipment in SAIs would be impractical, because collocation would be limited to interconnecting CLEC-provided facilities to the ILEC distribution plant.

[48] In the *UNE Remand Order*, the Commission recognized that the high costs and delays associated with collocation will impair a CLEC's ability to compete in the provision of data services. *UNE Remand Order* ¶¶ 306, 309. There is no reason to assume that the situation has improved.

77. Cabinets deployed in field locations that serve as cross-connecting terminals (SAIs) are sized for the number of terminations they enclose. As a result, the cabinets are manufactured in a large variety of sizes and descriptions. Cabinets designated for aerial/pole mounting have hardwired termination fields that are largely inaccessible (older designs were epoxy filled) thereby making them impracticable for an additional cable termination. Access to the termination field is accomplished by splicing into the pre-terminated cable stub that emanates from the cabinet itself. Any existing spare terminations were undoubtedly designed as part of the original job when the hardware was selected as a means to account for future growth without the need to replace the existing hardware.[49]

78. All of the above-listed difficulties associated with remote deployment of transmission-related electronics at remote terminals (or other interconnection points) make it virtually impossible for CLECs to offer competing services when ILECs have deployed DLC systems supporting such electronics.

79. This reality, coupled with the ILECs' incentive and ability to impede competition by limiting the amount of collocation space available for competitors, has proven to be a major barrier for CLECs.[50] But CLECs must also confront serious economic constraints and practical limitations, such as rights-of-way access, ability to interconnect to copper, and the other issues noted above.

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[49] As with ground-mounted cabinets, accessing SAIs with an additional cable (assuming termination space inside the cabinet were available) would be most impracticable if not impossible, since the existing hardware is effectively "locked" together in concrete. Moreover, it is not unusual to find the SAI and DLC cabinets on a common concrete pad, which further exacerbates the entry problem.

[50] *Advanced Services Order* ¶ 56.

80. And even if a CLEC could overcome all of these practical hurdles, deployment would only make sense if the CLEC could accomplish it at a per-subscriber cost comparable to that which the ILEC can achieve. Collocation at an RT, however, will almost always be economically impracticable. Experience has shown that CLEC collocation at the central office requires a formidable commitment,[51] but central office collocation costs can at least be amortized over the entire universe of potential customers that a CLEC might expect to win out of the entire central office.[52]

81. The costs of RT collocation may be marginally smaller than those of collocating at the central office, but the universe of potential customers is significantly smaller (and the number of necessary collocations significantly larger), and so the per-customer cost is vastly higher. By network design, the number of customers that an ILEC remote terminal (and to a greater extent, an SAI) usually serves is a small fraction of the number of customers served by the associated central office. In fact, the level of concentration present at a remote terminal is often as low as one hundred or a few hundred lines in total, of which any individual CLEC can only expect to capture a small percentage.[53] As a result, the CLEC's costs must be amortized over a much smaller number of potential customers, *i.e.*, the fraction of customers served by the

[51] *See UNE Remand Order* ¶¶ 262-266 (finding that collocating in incumbent LEC central offices imposes material costs and delays on a requesting carrier and materially diminishes a requesting carrier's ability to self-provision circuit switches to serve residential and small business market).

[52] If requesting carriers can obtain nondiscriminatory, cost-based access to the enhanced extended link, collocation costs would decrease significantly because they would only need to collocate in as few as one incumbent LEC central office in an MSA to provide service. *See UNE Remand Order* ¶ 288.

[53] In some extreme circumstances, some RTs serve only 4 to 8 homes, as is the case in BellSouth territory. *See* NGRT Public Forum at 34-35.

remote terminal that they might win.[54] Therefore, the cost of establishing an entire collocation arrangement at each remote terminal will be prohibitive in virtually every case.[55] A CLEC must incur relatively high fixed costs for site preparation, including rights of way, structure, cable, hardwire, excavation/restoral costs, as well as the costs for common control electronics and associated channel banks if a DLC deployment is being considered. All of these costs must be recovered from the base of customers addressed via the RT. It would not be unusual for a CEV DLC site to cost $250,000 and cabinet sites to cost $50,000 to $100,000, excluding facility costs necessary to connect the RT to the ILEC SAI or to connect the RT to the CLEC network.

82. Furthermore, once an ILEC's RT is established, as each user is gained, a portion of the capacity is moved into working status by merely installing a line card (plug-in). Such cards are frequently able to handle multiple users on a single card. Unlike the ILEC, which has deployed similar equipment to serve its entire franchised geography with POTS service and now seeks to leverage that position to provide additional service opportunities, a CLEC must take serious risks to deploy such costly equipment with the uncertain prospect of a financial reward that can only be achieved if a significant market share is achieved.

83. For similar reasons, adjacent collocation is almost always economically prohibitive. The economic reality is that remote deployment of transmission-related electronics by CLECs is unlikely to occur in most areas and is not feasible except in the most extraordinary

[54] *See Deployment of Wireline Services Offering Advanced Telecommunications Capability, Implementation of the Local Competition Provisions of the Telecommunications Act of 1996* CC Docket Nos. 98-147, 98-96, Ex Parte of Catena Networks, Inc. (filed Apr. 6, 2000).

[55] For a DLC to be practical and economic, it must be nearly fully utilized. The ILEC can realize these necessary economies of scale because it has designed its remote terminal to efficiently serve most of the entire base of customers assigned to the remote terminal. CLECs cannot reasonably expect to achieve such scale.

circumstances. Moreover, connecting carriers cannot begin such construction until they go through the lengthy and expensive process of obtaining rights of way and permits to construct a parallel cabinet, a process that may be slowed by issues of security, service disruption, or aesthetics. Moreover, the outcome of such a process is by no means certain. Indeed, neighborhoods and governmental entities likely will oppose construction of "remote terminal villages."

84. Collectively, all of these limitations lead to the inevitable conclusion that, at its best, remote terminal collocation will be used only in isolated circumstances,[56] and will never support mass market competition.

B. When Next Generation Architecture Is Deployed, Spare Copper Cannot Provide CLECs With Comparable Access to the ILECs' Improved Networks.

85. It is important that ILECs not be allowed to force CLECs to accept access to spare copper in lieu of the right to the entire loop when they have deployed next generation architecture. Such an "exchange" would not provide CLECs comparable access to the ILECs' improved network capabilities. Spare copper facilities that extend between the central office and the customer's premises, *i.e.* "home-run copper," are not substitutes that assure CLECs will have access to the full capabilities made possible by the use of shorter copper runs, signal splitting at the RT and the multiplexing of voice and data bit streams onto fiber from RTs to an ILEC central office.

86. In the *UNE Remand Order*, the Commission concluded that one of the four prerequisites to the unbundling of packet switching capability is the lack of spare copper

[56] Remote terminal collocation remains a possibility in campus arrangements and large building environments where space may be negotiated with owners and interconnection with the ILEC's is achievable.

facilities that are "capable of supporting the xDSL services the requesting carrier seeks to offer,"[57] and that permit the CLECs to offer "the same level of quality for advanced services" as that offered by the ILEC (or its data affiliate).[58]

87. When electronics are deployed in the remote terminal, however, it is virtually impossible for a CLEC to obtain a "home run" copper loop that will support transmission rates equivalent those obtained on the copper *sub*loop that terminates in the remote terminal.[59] As indicated in the table below,[60] DSL electrical signals necessarily lose their strength over distance. Thus, the longer the loop, the weaker the signal strength (and the greater the impact of noise) on that loop. The corollary condition is also clear: the shorter the loop length, the higher the feasible transmission rates. For example, ADSL technologies provide network-to-subscriber data transfer rates as a function of the length of the copper facility employed, as follows:

Data Rate	Distance
1.544 Mbps	18,000 ft.
2.048 Mbps	16,000 ft.
6.312 Mbps	12,000 ft.
8.448 Mbps	9,000 ft.
12.960 Mbps	4,500 ft.

57 *UNE Remand Order*, Appendix C (citing current 47 § 51.317(c)(5)(ii)).

58 *UNE Remand Order* ¶ 313.

59 Despite the limitations of spare copper, as SBC and other ILECs (and their data affiliates) migrate their customers to fiber or fiber-copper loops, requesting carriers should have the opportunity to use spare copper where and when it is available.

60 *See General Introduction to Copper Access Technologies, at* http://www.adsl.com/general_tutorial.html (last visited Oct. 10, 2000).

25.920 Mbps	3,000 ft.
51.840 Mbps	1,000 ft.

88. As a result, home-run copper will invariably provide transmission speeds, data rates or bandwidth (the terms are synonymous) that are slower than those delivered on the shorter copper subloops that terminate at the ILEC's remote terminal. This reduces transmission capacity that competitors can provide to customers. As the above chart indicates, a 4,500 foot copper segment allows for the transmission of data at a rate more than 8 times faster than an 18,000 foot copper loop.[61]

89. This, in turn, limits the type of services that customers can purchase and imposes a severe marketplace disadvantage on competitors.[62] For example, very high data rate DSL ("VDSL") technology has the potential to offer upstream data rates in excess of 1.5 Mbps and downstream data rates of 12.96 Mbps. Such data rates, however, are only obtainable when the copper segment is shorter than 4,500 feet. Thus, a shorter copper segment will allow the ILEC (or its affiliate) to offer its DSL customers not only a significantly faster data rate, but also emerging services that require very high transmission rates, such as video streaming.

[61] Of course, to the extent that the spare copper loop is over 18,000 in length, a CLEC likely will not be able to provide an ADSL service at all.

[62] *Applications of Ameritech Corp, Transferor, And SBC Communications Inc., Transferee, For Consent to Transfer Control of Corporations Holding Commission Licenses and Lines Pursuant to Sections 214 and 310(d) of the Communications Act and Part 5, 22, 24, 25, 63, 90, 95 and 101 of the Commission's Rules*, CC Docket No. 98-141, Declaration of Gary Rall in Support of Comments of AT&T Corp. in Response to SBC's Request for Interpretation, Waiver or Modification of the SBC/Ameritech Merger Conditions ¶ 11.

90. For all of these reasons, CLECs will invariably be unable to provide a DSL service that operates with "the same level of quality" as that provided by the ILEC or its data affiliate employing next generation architecture if the CLECs must rely on home run copper.

VI. CONCLUSION

91. While next-generation RT architecture greatly enhances the functionality of the local loop, it does not change the basic functionality of the loop *at all*. Since the 1960s, ILECs have sought to enhance transmission functionalities of the loop for voice service by: 1) decreasing reliance on the copper segment of the loop; 2) adding multiplexers, remote terminal and central office electronics; and 3) increasing the use of fiber-plant from the remote terminal to the central office. The RT developments occurring today merely represent the next logical step in this process, namely, enhancing the transmission functionalities of the loop to efficiently accommodate voice and data telecommunications services. Like the enhancements made to traditional architecture, these next generation RT developments enable ILECs to modify their loops to enhance transmission functionality even further by: 1) continuing to decrease the length of copper subloops; 2) moving more loop electronics from the central office to the remote terminal and adding more transmission enhancing electronics at the central office; and (3) increasing the uses and capabilities of fiber between the remote terminal and central office to transmit all of the customer's traffic in an efficient manner. None of these modifications, however, alter the basic transmission functionalities of the loop. Accordingly, all of these developments constitute capabilities of the local loop that competitors need -- and are entitled -- to access. In sum, there is simply no other viable option available to the CLECs that can support mass-market competition.

EXHIBIT B - Remote Terminals

1. The remote terminal may be a controlled environmental vault ("CEV"), a hut, or a cabinet. A CEV is a structure that is below ground, similar to a manhole, *i.e.*, a pre-cast rectangular concrete box (Maxi = 10'W x 24'L x 8'H, Mini = 8'W x 16'L x 8'H) that is assembled from two parts (a top and a bottom) which allows the placement of an equipment pallet into the bottom portion prior to final assembly.

2. Generally a hatch type assembly at one end on top permits entry, while conduits enter the structure at the ceiling level on the short wall opposite the entry space. The "short" walls (which are the width of the rectangle) usually contain various mountings such as a breaker panel and environmental detectors (such as a smoke alarm, temperature alarm, etc.) at the entry end and only conduits on the opposite end. The "long" walls on the other hand are typically occupied with relay racks for electronics. Opposite the electronics are protector terminations for the copper cable pairs arriving from the Feeder Distribution Interface ("FDI" —the interface between feeder and distribution cables) which in turn are hardwired overhead to the electronics. Fiber feeder cables transporting the signals back to the central office enter the CEV via the same conduit window and are terminated in close proximity to the multiplexer/common control assembly of the electronics.

3. A hut is an above-ground, prefabricated concrete structure with dimensions of approximately 10'W x 24'L x 8'H (Maxi) or 8'W x 16'L x 8'H (Mini). The structure can have various facades (e.g. rough pebble, brick or wood) as surrounding architecture dictates. These structures usually contain sufficient relay racks to accommodate designed DLC requirements and

ancillary hardware (e.g. Bulk Power, Protector Distribution Frame, Repeater Shelves, etc.) Huts are generally not located in buildings but rather are located in the field.

4. A cabinet is a small weatherproof metal enclosure used to house DLC equipment. Cabinets contain heat exchangers to help dissipate heat from the structure without introducing outside air to the equipment chambers. While there are a number of different manufacturers, the cabinets are normally sized to contain sufficient DLC systems and ancillary hardware to support the engineering design. Typically, the dimensions are 112"W x 46"L x 72"H, 93"W x 46"L x 72"H, or 44"W 42"L x 72"H. Cabinets are accessible from the front and rear for shelf assemblies, and at the end(s) for splice/power chamber and terminations. Cabinets are generally not located in buildings but rather are located in the field.

5. A Cabinet is generally used to serve a range of 24 to 2,016 lines, although this range varies based on development in plug-in cards and the ability to expand a cabinet's capacity with adjacent structures. Cabinets are the smallest structures used as remote terminals, and also, by far, the most common.

I declare under penalty of perjury that the foregoing is true and correct.

____
Joseph P. Riolo

Dated: This __ day of _____________, 2000

DCDOCS:180836.4(3vj804!.DOC)

EXHIBIT A

EXHIBIT A - IDLC/UDLC LOOP ARCHITECTURE

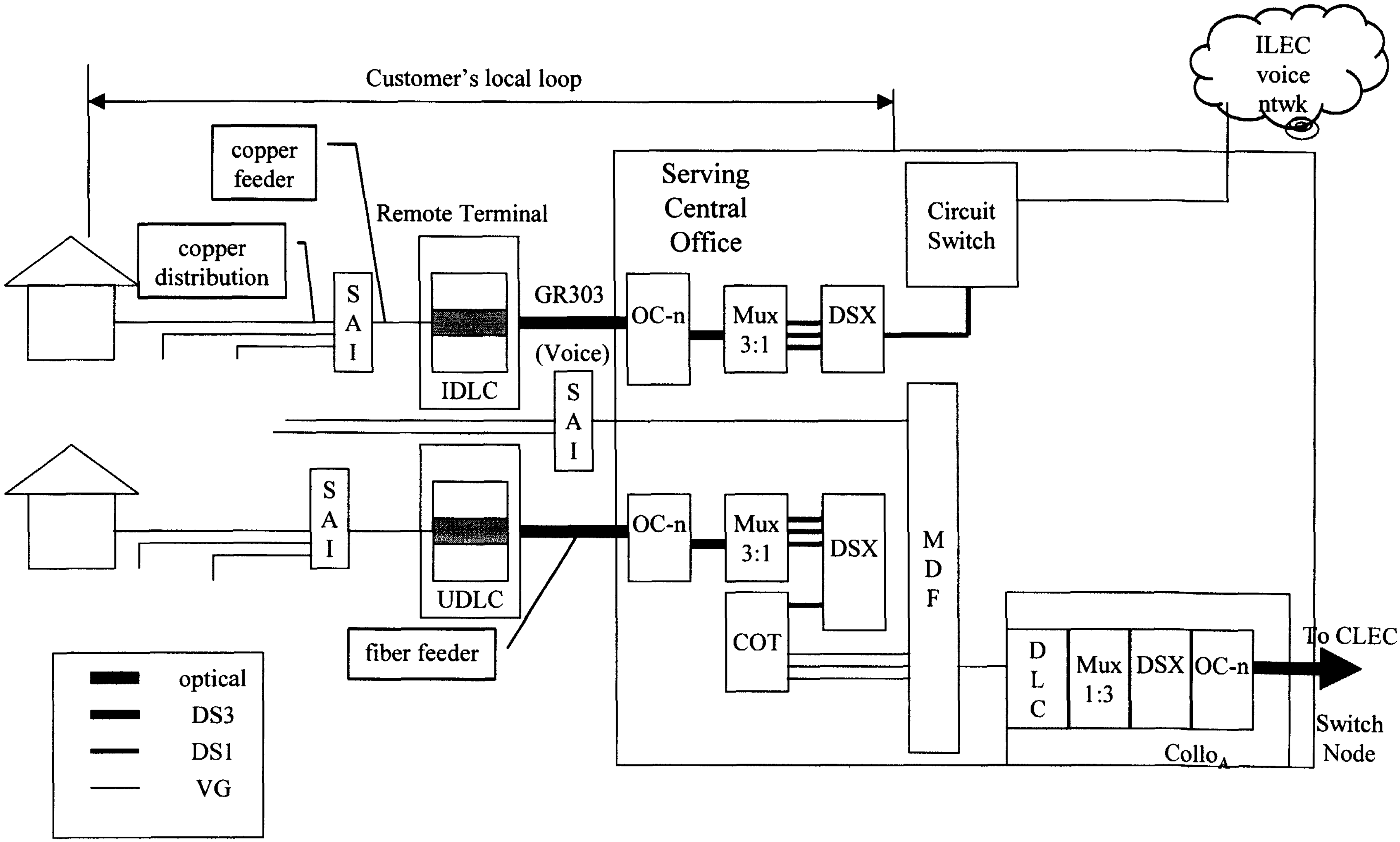

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EXHIBIT C

Exhibit C - Next-Generation Loop Architecture